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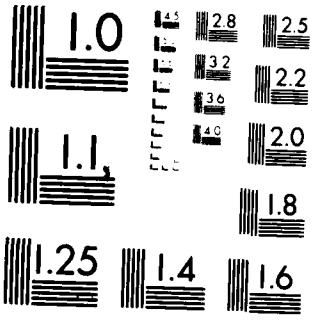

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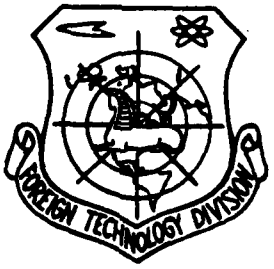
FOREIGN TECHNOLOGY DIVISION

SCIENTIFIC-TECHNICAL CONFERENCE ON ACYCLIC ELECTRIC MACHINES

by

B.L. Aliyevskiy



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Block	Italic	Transliteration	Block	Italic	Transliteration
А а	*А а*	A, a	Р р	*Р р*	R, r
Б б	*Б б*	B, b	С с	*С с*	S, s
В в	*В в*	V, v	Т т	*Т т*	T, t
Г г	*Г г*	G, g	У у	*У у*	U, u
Д д	*Д д*	D, d	Ф ф	*Ф ф*	F, f
Е е	*Е е*	Ye, ye; E, e*	Х х	*Х х*	Kh, kh
Ж ж	*Ж ж*	Zh, zh	Ц ц	*Ц ц*	Ts, ts
З з	*З з*	Z, z	Ч ч	*Ч ч*	Ch, ch
И и	*И и*	I, i	Ш ш	*Ш ш*	Sh, sh
Й й	*Й й*	Y, y	Щ щ	*Щ щ*	Shch, shch
К к	*К к*	K, k	Ъ ъ	*Ъ ъ*	"
Л л	*Л л*	L, l	Ы ы	*Ы ы*	Y, y
М м	*М м*	M, m	Ь ь	*Ь ь*	'
Н н	*Н н*	N, n	Э э	*Э э*	E, e
О о	*О о*	O, o	Ю ю	*Ю ю*	Yu, yu
П п	*П п*	P, p	Я я	*Я я*	Ya, ya

*ye initially, after vowels, and after ъ, ь; e elsewhere.
When written as ё in Russian, transliterate as yё or ё.

RUSSIAN AND ENGLISH TRIGONOMETRIC FUNCTIONS

Russian	English	Russian	English	Russian	English
sin	sin	sh	sinh	arc sh	$\sinh^{-1}$
cos	cos	ch	cosh	arc ch	$\cosh^{-1}$
tg	tan	th	tanh	arc th	$\tanh^{-1}$
ctg	cot	cth	coth	arc cth	$\coth^{-1}$
sec	sec	sch	sech	arc sch	sech^{-1}
cosec	csc	csch	csch	arc csch	csch^{-1}

Russian	English
rot	curl
lg	log

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SCIENTIFIC-TECHNICAL CONFERENCE ON ACYCLIC ELECTRIC MACHINES

B. L. Aliyevskiy, Associate Professor,
Candidate of Technical Sciences

At the Moscow Order of Lenin Aviation Institute the interschool and interbranch scientific-technical conference on acyclic machines was held. The participants of the conference heard and discussed 35 reports. The work of the conference was divided into three sections: 1) theory and designing of acyclic electric machines; 2) movable electric contact; 3) electromagnetic fields in acyclic machines. For the opening of the conference a program and theses of reports were published, and also a collection of works from the conference "Acyclic electric machines" ("Informelektro" Publishing House, Moscow, 1969).

The summary report "Modern state and future development of acyclic machines," by Professor A. I. Bertinov, Doctor of Technical Sciences, and Associate Professor B. L. Aliyevskiy (MAI), Candidate of Technical Sciences, was devoted to a brief analysis of questions of theory and calculation, a description of the newest constructions of acyclic machines and special types of them, and the problem of movable contacts and practical outlooks. Direct-current acyclic machines are implemented on heavy current (up to hudreds of kilomaps) with relatively low voltage (from units to tens of volts). Their advantages are: simplicity of design, absence of pulsations of generated voltage and current, high overload capacity, high efficiency

(up to 98%). In a pulsed mode homopolar generators provide amplitude values of current higher than a million amperes.

Homopolar generators are used in the electrochemical industry for the electrolytic production of chlorine and in the production of aluminum; for electric welding using the resistance method, and for other purposes. Special installations with a group of homopolar generators are used for the power supply of arc wind tunnels.

In the Soviet Union work on acyclic machines was carried out during 1933-39 at the Yaroslavskiy Electromechanical Plant under the leadership of I. P. Ivanov and B. V. Kostin. At the present time the industrial production of acyclic machines in the USSR is not organized. A number of organizations are carrying out investigations of test models of low-power acyclic machines for the purpose of studying their modes of operation, refining the methods of calculation, and working out the individual structural units. The most important element in the construction of acyclic machines is the contact device. The use of liquid-metal contacts on a base of low-melting metals (mercury, sodium-potassium, gallium-indium alloys) conditioned considerable progress in the development of heavy-current acyclic machines. The creation of a high-speed, reliable, long-lived contact is a serious problem and requires the further carrying out of scientific-research and test-design operations.

In electrical engineering the use of superconducting magnetic systems, and especially of pure metals in the case of cryogenic cooling, leads to the development of a new type of acyclic machines, machines which do not have ferromagnetic magnetic circuits. In England (IRD firm in Newcastle) they have developed an acyclic electric motor with a disk rotor and superconducting inductor. The motor has a power of 2400 kW, voltage of 500 V, current of 5.5 kA, rate of rotation of 200 rpm, and efficiency of 97%. It is intended for the electric drive of a circulation pump in a high-power energy system. Based on its indices (weight, dimensions, cost) this acyclic motor is better than the corresponding collectors or asynchronous machines in ordinary use. Special types of acyclic machines - generators of periodic pulses, ac-dc converters, electromagnetic clutches, are also used advantageously in different areas of the national economy.

Professor D. A. Gorodskiy, Doctor of Technical Sciences (VNIIEM), presented the report "Law of homopolar induction as the most common expression of the law of electromagnetic induction," in which the discussion included the formulation of the law of electromagnetic induction in the form of a derivative of flux linkage in time and in the form of a product of induction, length of the conductor, and rate of its transfer. The conclusion was made that the second formulation is the most general, although in individual cases the first formulation possesses a number of practical advantages.

The report by V. I. Kokuchayev (FVNIIEM, Istra), "Phenomenon of homopolar induction and the effect of the formation of an equivalent electric charge," was devoted to proof of the emergence in an isolated closed body, including sources of a rotating magnetic field of homopolar induction, of electric charges, the algebraic sum of which is different from zero. On the basis of this phenomenon it is possible to create physical instruments for measuring the concentration of conduction electrons in different types of current conductors.

In the report by engineers G. S. Veysig, M. M. Karpenko and A. N. Sadovskiy (Institute of Physics SOAN USSR, Krasnoyarsk) the requirements were set forth for homopolar generators which function in installations of strong magnetic fields: strong currents and relatively low voltages; smooth adjustment of voltage; high degree of stability and minimal values of current pulsations.

Doctor of Technical Sciences, Professor I. S. Rogachev and assistant [junior member of staff] L. I. Yantovskiy (KhPI), in the report "Shock homopolar generator of pulses with plasma current collection," considered briefly the main theoretical questions, calculation correlations, and construction of a pulsed generator of the cylindrical type. The generator is accelerated in a motor mode and converts the kinetic energy stored in the rotating rotor into the energy of an electric pulse with heavy current (in the case of conversion into the generator mode). The greatest rate of rotation is permitted by homopolar generators with plasma current collection on the base of an arc discharge between rotating and fixed electrodes. Plasma contact makes it possible to readily form pulses of current with an assigned curvature of the leading and trailing fronts.

A general form is given of a designed pulse generator on 200 V, 300 kA, with a duration of 1 s and an on-off time ratio of 60 s.

In the report by engineer D. V. Lokshin, Candidate of Technical Sciences Z. B. Neyman, and Candidate of Technical Sciences A. T. Tsirkunenko ("Uralelektrotyazhmash"), "Pulsed high-power homopolar generators," the special features of construction of acyclic machines with heavy current and high voltage for pulsed modes of operation with liquid-metal movable contacts are considered, and the layouts of the generators and contact devices proposed by the authors are described.

Engineer B. V. Kabelev (MAI) in his reports analyzes the electroenergy characteristics of the process of free discharge (without over excitation) of a homopolar generator on an inductive load; optimal correlations of geometric dimensions of the system of excitation of the homopolar generator without a ferromagnetic circuit in the case of power supply of the inductor by direct current and in the case of pulsed power supply.

The experimental investigation of models of homopolar generators without a ferromagnetic circuit of the cylindrical and disk types was treated in the report by Doctor of Technical Sciences A. I. Bertinov et al. (MAI). A comparison of calculated and experimental data made it possible to establish the suitability of different expressions for determining the emf of generators and to recommend their use depending on the characteristic dimensions of the machines.

Candidate of Technical Sciences L. A. Sukhanov and engineer G. A. Karmonov (IEM, Leningrad) in the report "Development and some results of the experimental investigation of an acyclic machine with liquid-metal contacts" presented the operational characteristics and special features of construction of a cylindrical generator on 5000 A, 0.75 V, 5000 rpm.

The report by Candidate of Technical Sciences, Associate Professor A. V. Loos, Doctor of Technical Sciences, Professor G. A. Sipaylov, and post-graduate student A. D. Chesalin (TPI), "Alternating current homopolar generator as a source of stable frequency," considers different types and special features of construction and application of homopolar generators with excitation on alternating current.

An important property of these generators is the non-dependence of their frequency on rate of rotation: it is determined by the frequency of excitation. In the report by B. L. Aliyevskiy, "Alternating current homopolar generators of low frequency for power supply of devices for induction mixing of melted metals," it is shown that the inductors of a traveling field of the mixers of steel-smelting furnaces of the SEP series with a frequency of 0.3-1 Hz have currents of up to several kiloamps with a relatively low voltage. It is advisable to power them from homopolar generators, since the electromechanical layouts of frequency conversion which are used contain 8-10 machines each. The main calculation correlations of the generators are given as well as the layouts for power supply of two- and three-phase inductors.

A group of reports by engineer V. N. Artemov, Candidate of Technical Sciences V. A. Glukhikh, engineer V. V. Ivanov, engineer B. G. Karasev, and engineer V. V. Kharitonov dealt with the electromechanical storage and conversion of energy with the use of homopolar generators and the investigation of their shock modes, and reflect the experience of designing and operating acyclic machines of different types: disk, cylindrical with solid and hollow rotors, and those having liquid-metal contacts.

Special types of acyclic machines were considered in the reports by engineer D. D. Panikratov and Candidate of Technical Sciences V. I. D'yakov (Ivanovsk Power Institute) - "Theoretical and experimental investigations of homopolar acyclic sliding couplings and brakes"; Candidate of Technical Sciences I. R. Parts and Candidate of Technical Sciences R. R. Parts (Tallin Pedagogic Institute) - "Distribution of the magnetic field under the central part of the stator of a homopolar converter"; R. R. Parts - "Basic inductive resistance of a homopolar converter"; engineer E. G. Korolev (ENIMS) - "Use of a homopolar generator as sensor of accelerations."

The report by B. L. Aliyevskiy and N. N. Popov (MAI) "Criteria of similarity in the physical modeling of acyclic machines" contains criteria and scales of modeling for machines with cores and without a ferromagnetic circuit. Also considered are the bases of modeling a liquid-metal ring contact for acyclic machines.

A. Ye. Klimovich, D. V. Lokshin, Z. B. Neyman, G. N. Perel'-

shteyn, A. T. Tsirkunenko ("Uralelektrotyazhmash" plant) and Candidate of Technical Sciences S. P. Yatsenko (UFAN) in the report "Use of gallium alloys in devices of liquid-metal sliding contacts for acyclic machines" and A. Ye. Klimovich and G. N. Perel'shteyn in the report "Experimental investigation and calculation of losses in liquid-metal sliding contacts for acyclic machines" bring out the main physical characteristics of gallium-indium and other gallium alloys; the investigation of corrosion resistance of construction materials in these alloys; a description of a test motor-generator installation of the acyclic type; method for calculating the losses of power in ring contacts of different types.

A group of reports was devoted to the investigation of hydro- and magneto-hydrodynamics of liquid contact devices, the investigation and calculation of electrical and mechanical losses in them, and the theoretical investigation of electromagnetic fields.

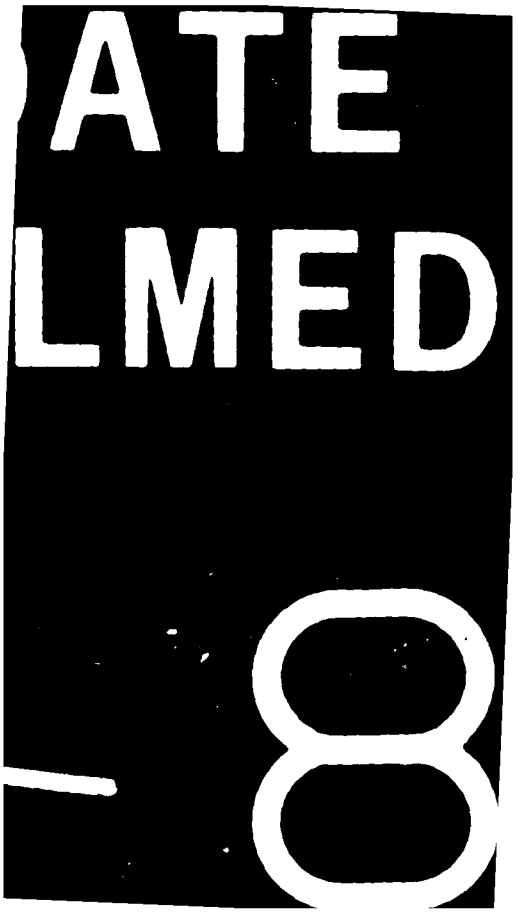
At the sessions they also heard reports on problems which are related to acyclic machines, for example, the report by engineer Ye. G. Oleynikov (Kharkov) "Phenomena of homopolar induction in high-power steam turbines and its influence on the output signal of induction systems of control."

The conference clarified the state of work on acyclic machines in our country and noted some outlooks. A general point of view was established for a number of scientific-technical questions. Further investigative and test-design work is necessary in the following directions: methods of optimal designing with the use of digital computers and optimal structural layouts of acyclic machines for prolonged and pulsed modes of operation; current-collecting devices on a base of liquid metals, and also plasma and special brush current collectors, and cooling systems (water, cryogenic); the use of superconductors for inductors of homopolar generators and motors; special types of acyclic machnies.

In the resolution of the conference it is noted that it is expedient to use acyclic machines in a number of branches of industry and scientific investigations in the interests of the national economy of the country. Work on acyclic machines is being conducted in the USSR, the USA, England, France, Japan, Austria, Rumania, the FRG, Australia and India, which is testified to by journal and patent literature.

For the creation and implementation in industry of large acyclic machines it is necessary to have the unification and coordination of efforts of all organizations engaged in their development. As the industrial-technical base the conference recommended the Sverdlovsk plant "Uralelektrotyazhmash" im. V. I. Lenina. For the purpose of exchanging experience and considering the results of work it was recognized as advisable to have periodic (once every 3-4 years) scientific-technical conferences on acyclic machines.

The conference decided to ask a number of ministries and departments about the development of work on acyclic machines in the corresponding NII [scientific-research institute], higher schools and industrial organizations, and the State Committee of the Council of Ministers of the USSR on Science and Technology - about the creation of a temporary scientific-technical commission on acyclic electric machines. The commission should establish the needs of the national economy of the country for acyclic machines, clarify the technical requirements for them, and determine the theme, period, and place of carrying out the next conference.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